

Riparian/Wetland Project Information Series

No. 25

November, 2008



Pre-soaking hardwood willow cuttings for fall versus spring dormant planting

Derek Tilley, Range Conservationist, and **J. Chris Hoag**, Wetland Plant Ecologist, USDA - Natural Resources Conservation Service, Plant Materials Center, Aberdeen, ID 83210

Introduction

The majority of riparian restoration and streambank bioengineering projects are installed in the spring as soon as weather permits working on the ground. There are a number of reasons why spring plantings are more prevalent than fall plantings. There is the fear that fall collected cuttings may have been stressed due to hot summer temperatures, reduced water availability, insects and disease prior to cutting. Another reason is the idea that a cutting left on the tree over winter should be healthier than a cutting taken off the tree and left in the frozen ground for six months. Another one is that the cutting might rot during the wet dormant period. In some cases, most of the project planning usually takes place during the “down time” over the winter months, and restorationists are eager in the spring to get back outside as soon as possible.

Dormant fall planting of hardwood willow cuttings can be a very successful technique. The cuttings must be planted with the bottom of the cuttings in the lowest watertable of the year and fall is the best time to plant because the watertable is often at its lowest or very near to it. Fall also presents a very long window of opportunity rather than the short planting window in the spring. Another reason to plant in the fall is that the cuttings are ready to start growing before the weeds get going in the spring. This is very important since in most springs, the ground is still too wet to get on with equipment to plant the cuttings when the weeds start growing. Typically, we have recommended that the cuttings not be soaked in the fall, since they will be sitting in the ground all winter and should be able to absorb enough moisture to become fully hydrated by spring.

So which is better, fall planted cuttings or spring planted cuttings? Each season has its positives and negatives. Fall planting often means that the cuttings are on the streambank much earlier than spring planted cuttings so some protection of the bank is possible when the spring runoff occurs. In many cases, some root growth will occur before runoff which will help with bank stability. To help increase fall planting establishment success, not only should the cuttings be harvested after leaf fall but new evidence indicates that soaking helps to hydrate the cuttings before they are planted.

The benefits of pre-soaking willow and cottonwood cuttings prior to planting have been well documented (Edwards and Kissock 1975; Krinard and Randall 1979; Pezeshki et al 2005; Tilley

and Hoag 2007). Pre-soaking dormant hardwood cuttings has been shown to improve survival, increase vigor and cause greater production of roots and shoots. However, all studies to date have examined pre-soaking followed by immediate planting in laboratory or field conditions in the spring where plants can immediately begin growing after planting. A literature review yielded no reports of tests evaluating the efficacy of soaking, followed by a fall-dormant planting.

Figure 1. Dormant willow cuttings soaking (left) and stored without soaking (right) in walk-in cooler at 4°C prior to fall planting.



To determine whether fall pre-soaking would increase establishment success, we compared cuttings planted in the fall following a 14 day pre-soaking treatment, to fall planted with no pre-soaking, spring planted following 14 day pre-soak, and a non-soaked spring planted control.

Twenty-five dormant cuttings of Peachleaf willow and Coyote willow from the PMC willow cutting nursery were harvested on November 19, 2007. Peachleaf willow cuttings were 20 inches long with a basal diameter of about $\frac{3}{4}$ inches and the coyote willow cuttings were 20 inches long with a basal diameter of approximately $\frac{1}{2}$ inches. Although we normally recommend using cuttings $\frac{3}{4}$ inches or larger, the source location of the coyote willow did not have many cuttings larger than $\frac{1}{2}$ inch. The best, most vigorous stems were selected, and they were smaller than expected. All side branches and terminal tips were removed at the time of harvest.

The cuttings were placed vertically in 5 gallon buckets filled 16 inches deep with water (80% of the cutting was in water). The buckets were then placed in cold-dark storage at 4°C for 14 days prior to planting (November 26 to December 10). Plants not soaked were placed in cold-dark storage at 4°C until planting (fig 1).

We then planted the soaked and non-soaked fall harvested cuttings on December 10, 2007 into 40 cubic inch Conetainers filled with a perlite/vermiculite mix and placed them outside (fig 2).



Cuttings for the spring treatments were harvested dormant on March 10, 2008 for peachleaf willow and March 21, 2008 for the coyote willow. On March 24, the spring harvested cuttings were placed in 5 gallon buckets to soak. Non-soaked spring-harvested cuttings remained in cold-dark storage. On April 7, 2008 we removed the cuttings being soaked and planted all of the spring collected cuttings (soaked and non-soaked) into 40 cubic inch Conetainers filled with the perlite/vermiculite mix.

After planting, all of the cuttings in the containers were placed in an outdoor 4' X 8' X 1' tank, so they could be watered equally via sub-surface irrigation (fig 3). We initially filled the tank so that water rose 3 inches up the cones. Water levels were then manipulated to rise and fall ensuring that we provided adequate moisture for sprouting and growth.

Figure 3. Cuttings in 4'x 8'x1' metal tank for irrigation and establishment.



On May 19 (42 days after spring planting) we evaluated percent survival then carefully removed the peachleaf willow cuttings from their cones and washed the soil away from the roots. Roots and shoots were removed and separated and air dried for four days and then weighed.

The coyote willow cuttings were grown longer than the peachleaf willow due to differences in growth rates. In order to have sufficient vegetation to accurately weigh, coyote willow cuttings were harvested on June 16 (70 days after spring planting) and weighed on June 24.

Dates for peachleaf willow				
	Collection	Soaked	Planted and moved outside	Biomass harvest
Fall non-soaked (F0)	11/19/07	NA	12/10/07	5/19/08
Fall 14 day soak (F14)	11/19/07	11/26/07-12/10/07	12/10/07	5/19/08
Spring non-soaked (S0)	3/10/08	NA	4/7/08	5/19/08
Spring 14 day soak (S14)	3/10/08	3/24/08-4/7/08	4/7/08	5/19/08

Dates for coyote willow				
	Collection	Soaked	Planted and moved outside	Biomass harvest
Fall non-soaked (F0)	11/19/07	NA	12/10/07	6/16/08
Fall 14 day soak (F14)	11/19/07	11/26/07-12/10/07	12/10/07	6/16/08
Spring non-soaked (S0)	3/21/08	NA	4/7/08	6/16/08
Spring 14 day soak (S14)	3/21/08	3/24/08-4/7/08	4/7/08	6/16/08

Results

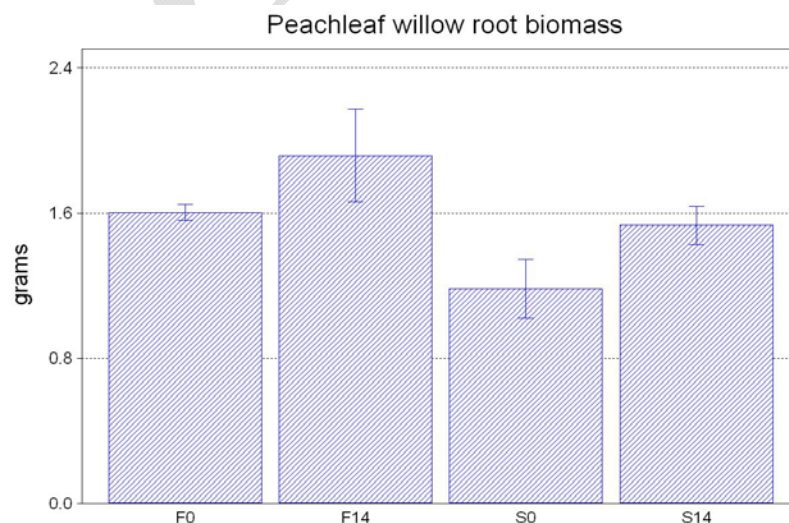
Peachleaf willow

We had 100% survival from the peachleaf willow cuttings. Root and shoot production, however, did show differences between treatments (fig 4). In terms of roots and shoots, the *pre-soaked cuttings harvested and planted in the fall had better root and shoot production than all other treatments*. The poorest producer of roots and shoots was the spring harvested cuttings that did not receive a pre-soaking treatment. Cuttings harvested and planted in the fall without soaking had root and shoot production similar to cuttings harvested in the spring that had been soaked. Also, for fall and spring collected materials, soaked cuttings performed better than non-soaked cuttings.

Coyote willow

Two cuttings died in the fall soaked treatment of the coyote willow trial reducing survival to 92%. The reason for the cutting mortality isn't known. All other cuttings from the three remaining treatments survived. Despite the somewhat lower survival, fall harvested and pre-soaked cuttings had significantly greater root production than the other treatments (fig 5). Similar to the peachleaf willow trial, the pre-soaked cuttings had better root production than their non-soaked counterparts. Shoot production for coyote willow was essentially the same for all treatments.

Figure 4. Root and shoot biomass production of peachleaf willow: harvested and planted in the fall with no pre-soaking treatment (F0), 14 day pre-soaking treatment (F14), harvested and planted in the spring with no pre-soaking treatment (S0) and a 14 day pre-soaking treatment (S14). Error bars are +/- 1 standard error.



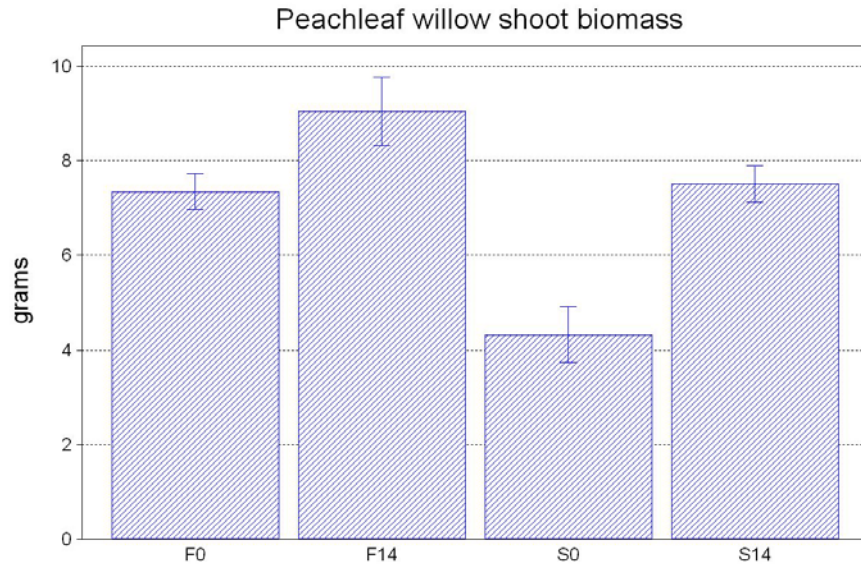
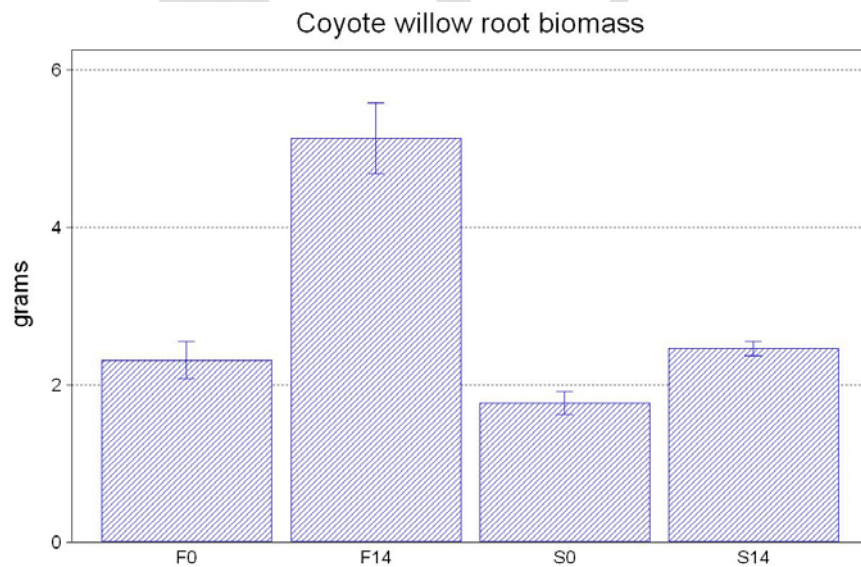
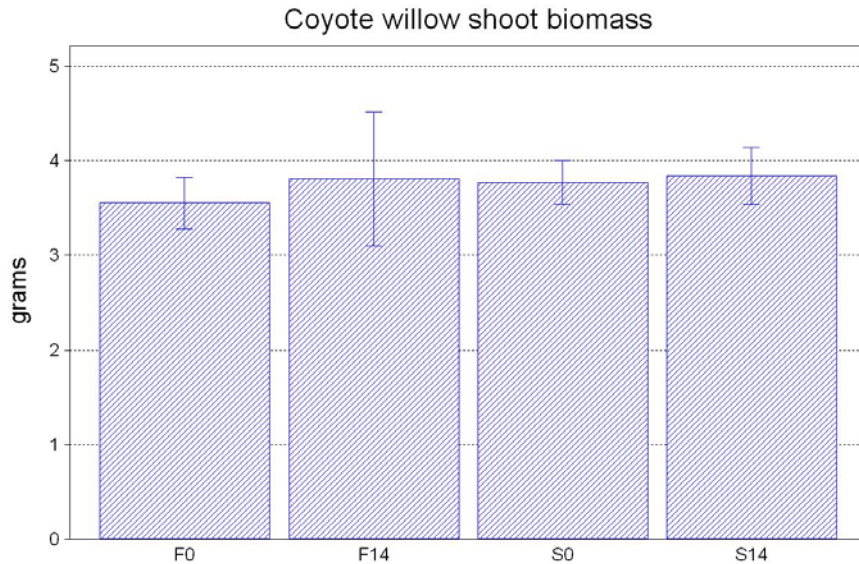


Figure 5. Root and shoot biomass production of coyote willow: harvested and planted in the fall with no pre-soaking treatment (F0), 14 day pre-soaking treatment (F14), harvested and planted in the spring with no pre-soaking treatment (S0) and a 14 day pre-soaking treatment (S14). Error bars are +/- 1 standard error.





Discussion

Woody plants (trees and shrubs) continue to lose moisture from their branches and needles over the course of the winter. Deciduous plants (plants dropping all of their leaves each fall), as well as evergreens, lose an appreciable amount of moisture through their branches, especially in windy environments. Additionally, when the ground temperatures near freezing, plant water uptake becomes very limited. Applying supplemental water after woody plants become fully dormant, but before the ground is completely frozen, is one way to reduce desiccation (Scianna, 2008). Essentially, a hydrated cutting is a better propagule regardless of the season.

Pre-soaking willow cuttings in the fall, prior to transplanting into cold, dormant conditions appears to give the cutting an added boost to help it maintain moisture levels through the winter and into the spring. In warm days of the later part of the dormant season, limited photosynthesis can occur through the stem and the soaking tends to induce the root primordia to start swelling. As the root primordia swells it pushes the roots out into the soil sooner than if the cutting had not been hydrated. This means that you will have a better adapted plant at the onset of the growing season which translates into higher establishment success.

These results suggest that presoaking then planting in the fall may be even more beneficial than presoaking planting in the spring. Soaking cuttings after a spring harvest helps to hydrate the stem and swell the primordia, but perhaps not as much as soaking the cutting in the fall.

References

- Desrochers A, Thomas BR. 2003. A comparison of pre-planting treatments on hardwood cuttings of four hybrid poplar clones. *New Forests* 26: 17-32.
- Edwards WRN, Kissonock WJ. 1975. Effect of soaking and deep planting on the vegetative propagation of *Populus* and *Salix*. In: FAO, International Poplar Commission 15 session. Rome, Italy. 13 p.
- Fink S. 1983. The occurrence of adventitious and preventitious buds within the bark of some temperate and tropical trees. *American Journal of Botany* 70(4): 532-542.
- Hoag JC. 1993. How to plant willows and cottonwoods for riparian rehabilitation. Aberdeen (ID): USDA Natural Resources Conservation Service, Aberdeen Plant Materials Center. Technical Note 23. 13 p.
- Hoag JC. 2005. Simple identification key to common willows, cottonwoods, alder, birch and dogwood of the Intermountain West. Aberdeen (ID): USDA Natural Resources Conservation Service, Aberdeen Plant Materials Center. Riparian/Wetland Project Information Series No. 19. 16 p.
- Krinard RM, Randall WK. 1979. Soaking aids survival of long unrooted cottonwood cuttings. *USDA Forest Service: Tree Planters' Notes* 30(3): 16-18.
- Martin LT, Pezeshki SR, Shields FD Jr. 2004. High oxygen levels in a soaking treatment improves early root and shoot development of black willow cuttings. *The Scientific World* 4: 899-907.
- Pezeshki SR, Brown CE, Elcan JM, Shields FD Jr. 2005. Responses of nondormant black willow (*Salix nigra*) cuttings to preplanting soaking and soil moisture. *Restoration Ecology* 13(1):1-7.
- Pezeshki SR, Shields, FD Jr. 2006. Black willow cutting survival in streambank plantings, Southeastern United States. *Journal of the American Water Resources Association* 42(1):191-200.
- Phipps HM, Hansen EA, Fege AS. 1983. Pre-plant soaking of dormant *Populus* hardwood cuttings. St. Paul (MN): USDA Forest Service, North Central Forest Experiment Station. Research Paper NC-241. 9 p.
- Schaff SD, Pezeshki SR, Shields FD Jr. 2002. Effects of pre-planting soaking on growth and survival of black willow cuttings. *Restoration Ecology* 10(2):267-274.

Scianna, J. 2008. Fall and winter watering of trees and shrubs-and other ways to prevent winter desiccation. In: Plant Materials Today. USDA-NRCS. Bridger, MT. 2p.

Stevens M, Fenchel G, Hoag JC. 2000. Coyote willow: Plant Guide. USDA Natural Resources Conservation Service. Baton Rouge (LA): National Plant Data Center. 10 p.

Tilley, D.J. and J.C. Hoag. 2007. Effects of pre-plant soaking treatments on hardwood cuttings of peachleaf willow. USDA-NRCS. Boise, ID. 7 p.

DRAFT